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$$=\frac{12}{\pi r^2(4\pi-3\sqrt{3})}\left[\int_0^r\left(\tfrac{3}{2}(\cos^{-1}\frac{x}{2r})^2-\pi\cos^{-1}\frac{x}{2r}+\tfrac{1}{2}\pi^2\right)xdx\right.$$

$$+\int_0^{\frac{1}{3}\pi}(4r^2\theta\cos^2\theta+\tfrac{1}{2}r^2\cot\theta\cos2\theta-\tfrac{1}{2}r^2\theta\operatorname{cosec}^2\theta)d\theta$$

$$\left.-2\int_0^{\frac{1}{2}\pi}(\tfrac{1}{2}r^2\theta+\tfrac{1}{4}r^2\cot\theta-\tfrac{1}{4}r^2\theta\operatorname{cosec}^2\theta)d\theta\right].$$

$$\therefore\ p=\frac{7\pi^2+8\pi\sqrt{3}-54}{3\pi(4\pi-3\sqrt{3})}.$$

NOTE.—This is problem 135 of *The Analyst*. Quite a discussion arose at the time of its first appearance, in which such eminent mathematicians of Prof. Benj. Pierce, of Harvard, took part. An incomplete solution by Professor Heaton was published. We believe Professor Zerr's solution is correct. ED. F.

100. Proposed by **LON C. WALKER**, Assistant in Mathematics, Leland Stanford Jr. University, Palo Alto, Cal.

Required the average distance between two points in opposite sides of a regular $2n$-gon.

Solution by J. SCHEFFER, A. M., Hagerstown, Md., and the PROPOSER.

From any point P at a distance x from the vertex A, in the side $AB=a$ of the regular polygon, draw PE perpendicular to the opposite side DC.

Let Q be any point in DC between D and E at the distance $=y$ from E. Then we have

$$PQ=\sqrt{a^2\cot^2\frac{\pi}{2n}+y^2}\ .$$

The average distance of all points in DE from the point P will be the same as the required average when the line PE is made to move parallel to itself the entire length of a side of the polygon.

The elements of AB and CD at the points P and Q are dx and dy, respectively. Therefore the required mean is

$$M=\frac{\int_0^a\int_0^x\sqrt{a^2\cot^2\frac{\pi}{2n}+y^2}\ dxdy}{\int_0^a\int_0^x dxdy}$$

$$=\frac{2}{a^2}\int_0^a\int_0^x\sqrt{a^2\cot^2\frac{\pi}{2n}+y^2}\ dxdy=\frac{1}{a^2}\int_0^a\left[x\sqrt{a^2\cot^2\frac{\pi}{2n}+x^2}\right.$$

$$\left.+a^2\cot^2\frac{\pi}{2n}\log\left(\frac{x+\sqrt{a^2\cot^2\frac{\pi}{2n}+x^2}}{a\cot\frac{\pi}{2n}}\right)\right]dx=\left[\tfrac{1}{3}\operatorname{cosec}\frac{\pi}{2n}-\tfrac{2}{3}\tan\frac{\pi}{4n}\cot^2\frac{\pi}{2n}\right.$$

$$+\cot^2\frac{\pi}{2n}\log\left(\frac{1+\sin\frac{\pi}{2n}}{\cos\frac{\pi}{2n}}\right)\Bigg].$$

COROLLARY. If $a=1$, $n=2$, then

$$M=\frac{2-\sqrt{2}}{3}+\log(1+\sqrt{2}).$$

Also solved by *G. B. M. ZERR*, and *HENRY HEATON*.

MISCELLANEOUS.

90. **Proposed by DR. E. D. ROE, Jr., Syracuse University, Syracuse, N. Y.**

I shot my rifle at different ranges and found the following table of elevations e, for the vernier peep sight, for the given distances s:

s	e
0	21.0
100	24 5
200	28.5
300	33.5
400	40.0
500	48 5

The distances are measured in yards. How shall a table of elevations be constructed, giving the arguments e, for every five yards up to 500 yards? Do not give the whole table, but explain the method, and illustrate by giving a computation, carrying the result to three places of decimals. An actual problem.

Solution by the PROPOSER.

The solution of this problem, which is doubtless somewhat arbitrary, was as follows: We have partly given and partly implied in the data, the following scheme:

s	0	100	200	300	400	500
e	21.0	24.5	28.5	33.5	40.0	48.5
Δe	3.5	4.0	5.0	6.5	8.5	
$\Delta^2 e$	0.5	1.0	1.5	2 0		
$\Delta^3 e$	0.5	0.5	0.5			
$\Delta^4 e$	0	0				

In this we notice that the fourth and third differences are constant, while the second are in arithmetical progression. Assuming that we have discovered the law, we may extend the second, third and fourth differences up to the column under 400, and thus have the complete data for interpolation by means of the method of finite differences. According to this method, if e_s denote the elevation for the distance s, we have,